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Abstract

We analyse the proposed "Stability Pact" for countries joining a European Monetary Union (EMU). In an EMU shortsighted governments fail to fully internalise the inflationary consequences of their debt policies. This results in excessive debt accumulation. Therefore, while in the absence of EMU governments have no incentive to sign a stability pact, under an EMU they prefer a stability pact which punishes excessive debt accumulation. With idiosyncratic shocks to the governments' budgets, an EMU combined with an appropriately designed stability pact will be strictly preferred to autonomy. While the stability pact corrects the average debt bias, inflation, which is attuned to the union-average debt level, is more stable.

Keywords: Stability Pact, European Monetary Union, political distortions, monetary policy, debt policy, inflation.

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1. Introduction

European monetary unification is inching closer. With it, the dicey issues of the relationships of the individual countries with a common monetary policy move into the spotlight of attention. One might take the point of view that there should be no problems at all: a conservative and independent European Central Bank (ECB) will simply ensure low and stable inflation, while the individual countries select the fiscal policies they prefer. But most commentators view these relationships as more complicated. In particular, there is the fear that a high-deficit member country or a member country in recession may successfully pressure the ECB into loosening its monetary policy. This will create additional inflation and, according to many theories, real effects in the entire union. In other words, there might be a feedback from the fiscal policy of a member country to economic conditions in all other countries, which are now transmitted more tightly via an influencable ECB[1]

In light of this worry, a "Stability Pact" has been proposed. The essence of the Stability Pact is to closely watch the fiscal deficit of each member country, and punish those, whose deficits are deemed excessive. The proposed punishment takes the form of a payment in the order of some non-negligible fraction of GNP. Given the intensive discussion about the Pact in the political sphere, it is of great importance to try to clear up the theoretical issues involved here. The purpose of this paper is to do exactly that.

Of course, there is a large literature on the strategic issues of monetary policy and monetary union, see for example the surveys and bookform contributions in CEPR (1991), Cukierman (1992), de Grauwe (1994), Eijffinger and de Haan (1996), Giavazzi (1988), Giovannini (1996), Kenen (1995) and Persson and Tabellini (1994). But very little has so far been contributed to understanding the relationships of countries after the monetary unification has taken place, and how they can be improved upon with additional institutional arrangements such as the Stability Pact.

[1]The issue of fiscal debt versus monetary policy is nicely discussed by Dornbusch (1996). He argues that the dangers of excessive debts for monetary policy are a thing of the past: "...the Maastricht criteria were fighting the last war, not a present issue. The debt issues are real, but their impact on monetary policy is not." This paper is written just in case the "last war" isn't quite over yet. Furthermore, in the context of multiple countries, additional strategic feedback issues arise, which are at the heart of this paper.

The role of the Stability Pact can be examined from a number of different angles, and we cannot possibly discuss all of these in this paper. Here, we just take one particular point of view: while it is unlikely to be the entire story, we believe it to be an important part of it. Our point of view is the following. Given their terminable stay in office, policymakers are often compelled into taking a rather short-term point of view. In particular, it often looks attractive to raise additional debt to pay for expenditures, which benefit in particular the constituency of the party in power, and then leave it to the successor to worry about repaying that debt. The successor will have to rely on a mix of inflation as well as taxes to deal with this problem.

In such a situation, a Stability Pact comes in handy. With such a Pact, a number of countries agree beforehand to punish each other if somebody raises too much debt. The idea is to use the enforcement by others to commit to a low-debt policy beforehand, a policy, which is beneficial from an ex-ante point of view. The problem will be that the other countries have no particular reasons to actually proceed with the punishment in case of a recalcitrant country: there is nothing at stake for the potential enforcers. As a result, signing a Stability Pact does not make sense for a group of independent countries.

Having a common central bank changes all that. While the successor to a high-debt policymaker will try to solve part of the debt problem by boosting inflation, this inflation channel will now operate through the ECB, imposing an inflationary burden on all other countries as well. Suddenly, there is something at stake for the other countries, and they are willing to be serious about enforcing fiscal responsibility. Signing a Stability Pact now makes sense and improves welfare for all participating countries. We therefore explain why we see countries entering a Stability Pact only after they have already agreed to join a monetary union, i.e. why we do not see a group of arbitrary countries elsewhere entertaining such a possibility.

While this reasoning may sound appealing, a more formal analysis is called for to clearly understand the mechanism and to iron out potential fallacies in the heuristic description above. We do this in the remainder of the paper. Based on the work by Alesina and Tabellini (1990), Tabellini and Alesina (1990) and Cukierman, Edwards and Tabellini (1992), in Section 2 we construct a model of centralised monetary policymaking and decentralised fiscal policymaking by governments which are myopic because they can be voted out of office. Section 3 explores debt policy in the absence of a Stability Pact. We study the effects of commitment, union size and central bank independence on equilibrium debt accumulation. Section 4 introduces the Stability

Pact and shows how governments that would otherwise not sign such a Pact, would want to do so if monetary unification goes ahead. Section 5 considers a variation, in which the first-period budget constraint is stochastic. It is shown that a Stability Pact widens the debt distribution, but that an optimal Stability Pact can be found for which countries would rather join the EMU than stay autonomous. Section 6 concludes the paper.

2. The Model

What we want to capture in our model is some interaction between several governments and a common central bank, in which the governments have the possibility to raise debt and in which the common central bank sets monetary policy. We want this model to have the property that governments would choose excessive amounts of debt in the absence of regulating constraints other than the need to repay the debt eventually: curbing these excesses will be the role of the Stability Pact. Such a feature captures the short-sightedness of governments in power alluded to in the Introduction: raising debt is attractive if some other future government has to worry about repaying it.

There are two periods ($t = 1, 2$). A European Monetary Union (EMU) is formed by n countries. Therefore, monetary policy is centralised, while fiscal policy is conducted at the national level. The situation of national monetary policymaking corresponds to the special case of $n = 1$.

Countries are assumed to be identical both in their economic and political structure and in their preferences. Consider some participating country i ($i = 1, .., n$). Society i's expected utility is given by

$$U_{S,i}(f_{1i}, g_{1i}, f_{2i}, g_{2i}) = u(f_{1i} + g_{1i}) + E[f_{2i} + g_{2i} - \pi^2/(2\phi)], \tag{2.1}$$

where $f_{ti} \geq 0$ and $g_{ti} \geq 0$ are public goods in period t and π is the common, union-wide inflation rate, which is determined in the second period. Parameter ϕ is the inverse of the degree of inflation aversion. $E[.]$ denotes the expectations operator. This utility function can be thought of as a social welfare function which aggregates the preferences of all agents in society. The function $u(.)$ is twice continuously differentiable with $u'(.) > 0$ and $u''(.) < 0$. For convenience, we assume that $u(0) = 0$ and that $u'(1) = 1$. Furthermore, we assume that $u'(2) < p$, where p is introduced below. We abstract from discounting.

There are two political parties, F and G, which are selected to run the government by an election with random outcome. Party F cares only about public good f_{ti}, while party G only cares about public good g_{ti}. Hence, the utilities of parties F and G are given by, respectively:

$$U_{Fi}(f_{1i}, g_{1i}, f_{2i}, g_{2i}) = u(f_{1i}) + E[f_{2i} - \pi^2/(2\phi)],$$

$$U_{Gi}(f_{1i}, g_{1i}, f_{2i}, g_{2i}) = u(g_{1i}) + E[g_{2i} - \pi^2/(2\phi)].$$

Without loss of generality we assume that in each country party F is in office in period 1. It will be re-elected at the end of the first period with an exogenous probability of p, where $0 < p < 1$. The assumption that each of the parties only cares about one public good is not uncommon in this literature. Economically, each party just caters to its own constituency. In particular, if some party looses power, but leaves a lot of debt to its successor, that successor can only afford rather meager expenses in the other public good while repaying the debt under the budget constraint to be stated below: this meagerness, however, does not affect the constituency of the party that has just lost power. Thus, these assumptions capture the short-sightedness aluded to above.

There is unrestricted borrowing and lending on the world capital market. All debt is non-indexed. This reflects the usual practice in European countries. Ideally, the model should determine the optimal degree of debt indexation. However, to keep the analysis tractable, we do not explicitly model the factors that would make non-indexed debt optimal. One reason for having nominal debt would be the presence of shocks to the budget. In that case, nominal debt can be used as a way to hedge the real revenues required by the government [see Bohn (1988), Calvo and Guidotti (1993)].[2]

Before stating the budget constraints, it is important to introduce the impact of a Stability Pact on these constraints. We want a Stability Pact to result in a penalty for countries that raise too much debt: for our purposes, we will model this penalty as a linear function of excessive debt. We allow for penalties both in the period in which the debt is issued as well as in the period that the debt is repaid. A country running a surplus instead should not be similarly subsidized, however: penalties should not be allowed to be negative. Unfortunately, such a kink in the penalty function makes the analysis of the model hard. We therefore assume that the penalty function is

[2] An unfavourable shock to the budget would require an inflation surprise which reduces real debt servicing costs, while a favourable shock requires unexpectedly low inflation.

linear over the entire range of debt choices. One should thus keep in mind, that the model only delivers meaningful predictions, as long as countries do not run deficits below or, at least, not much below the penalty threshold in equilibrium. However, the equilibria which we are going to study all turn out to involve debt levels above the socially optimal level. For deviations from the socially optimal level in that direction, our linearity assumption should be fine. Regarding the penalties paid, we also need to make an assumption as to their usage. We assume, that the penalty payments will be distributed to the other countries, which benefits in particular countries with a small or no deficit.

We are now ready to state the government budget constraints. Assuming that all debt is paid off in the second period and that aggregate resources in each period are equal to one, the budget constraints of the governments (or resource constraints for the economy) in the first and second period are given by, respectively,

$$f_{1i} + g_{1i} = 1 + b_i - \psi_1(b_i - \bar{b}) + \left(\frac{1}{n-1}\right) \sum_{j=1, j\neq i}^{n} \psi_1(b_j - \bar{b}), \tag{2.2}$$

$$f_{2i} + g_{2i} = 1 - b_i[1 + \pi^e - \pi] - \psi_2(b_i - \bar{b}) + \left(\frac{1}{n-1}\right) \sum_{j=1, j\neq i}^{n} \psi_2(b_j - \bar{b}), \tag{2.3}$$

where b_i is the amount of debt issued by the first-period government and traded on the world market. For convenience, we have assumed that the real world market interest rate is zero. In order for risk-neutral agents to be willing to hold government bonds, the nominal interest rate, $1 + \pi^e$, includes a mark-up equal to the expected inflation rate. The ex-post real interest rate is given by $1 + \pi^e - \pi$.

We assume that $\psi_1 < 1$ and $\psi_2 > -1$: that way, increases in b_i will always result in an increase in the first-period budget and (for $\pi^e = \pi$) in a decrease in the second-period budget, if all other countries leave their debt level unchanged. However, we do not rule out at this point the possibility of a *subsidy* rather than a penalty to the incurrence of debt. Absence of a Stability Pact corresponds to $\psi_1 = \psi_2 = 0$. If a Stability Pact has been signed and country i accumulates debt in excess of $\bar{b}$ it pays a fine of $\psi_1(b_i - \bar{b})$ in period 1 and a fine of $\psi_2(b_i - \bar{b})$ in period 2.[3] Here $\bar{b}$ is some reference debt level (for example, 60% of GDP in the case of the Maastricht Treaty). The final term on the right hand sides of the budget constraints is the rebatement of the fines

[3]It may seem to be a bit peculiar to include a first-period punishment $\psi_1(b_i - \bar{b})$. However, this can be thought of as a punishment taking place almost immediately after the debt has been issued.

paid by the other members of the union. This rebatement ensures that countries have an interest in the ex-post enforcement of the punishment of other countries. The sum of the fines and the rebatements is zero in each period, hence the federal budget is balanced on a period by period basis.

Monetary policy is conducted at a supranational level by the European Central Bank (ECB). We assume that the common, union-wide inflation rate (which is selected in the second period) is under direct control of the ECB. In the absence of political pressure (that is, under complete independence), its objective would be to maximise $-\pi^2/(2\phi)$, where ϕ reflects how severely the central banker is punished for deviations from price stability. Such an objective function would reflect the spirit of the Maastricht Treaty, which gives the ECB a mandate for price stability. We allow, however, for the possibility that the ECB is not completely independent. In particular, the ECB attaches a relative weight λ ($0 \leq \lambda \leq 1$) to its objective under complete independence and a relative weight $1-\lambda$ to an equally-weighted average of the objectives of the second-period governments in each of the individual countries. Ignoring an irrelevant proportionality factor, the ECB's objective function is given by:

$$\begin{aligned} U_{ECB} &= -\frac{\pi^2}{2\alpha} + \frac{1}{n}\sum_{i=1}^{n}\left[1 - b_i(1+\pi^e-\pi) - \psi_2(b_i-\bar{b}) + \left(\frac{1}{n-1}\right)\sum_{j=1,j\neq i}^{n}\psi_2(b_j-\bar{b})\right] \\ &= 1 - \frac{\pi^2}{2\alpha} - (1+\pi^e-\pi)\frac{1}{n}\sum_{i=1}^{n} b_i, \text{ where } \alpha \equiv \phi(1-\lambda). \end{aligned} \tag{2.4}$$

Therefore, $\lambda = 1$ or, equivalently, $\alpha = 0$ corresponds to an extremely independent ECB, while $\lambda = 0$ or $\alpha = \phi$ corresponds to an extremely dependent ECB. If $0 < \lambda < 1$ or $0 < \alpha < \phi$, the ECB is partially independent and, therefore, more "conservative" than the representative agent in the union (that is, the ECB attaches a larger relative weight to price stability — see Rogoff, 1985).

Although the Maastricht Treaty requires the ECB to be completely independent, in reality one could well imagine countries trying to influence its policies through the appointment of Board Members or simply by putting sheer political pressure on the ECB.[4] Therefore we allow for the possibility that the ECB is partially independent. Moreover, it is interesting to explore how debt accumulation and the Stability Pact are affected by the degree of independence of the ECB.

[4]In this respect it is interesting to observe the "overt French efforts to set up a political council to track, or guide, the supposedly independent European (Central) bank" (The Economist, January 25, 1997, page 25).

3. No Stability Pact

In this section we study policies and welfare in the absence of a Stability Pact (i.e., $\psi_1 = \psi_2 = 0$). We do so in order to illustrate more clearly the effects of introducing such a Pact.

3.1. Benchmark: the Social Planner

Societies' welfare is highest if all policy instruments (both in the first and in the second period) are selected by a Social Planner (SP). Moreover, the SP is able to commit to an inflation rate announced before debt contracts are signed.[5] It is easy to see that the SP sets $\pi = 0$, $b_i \equiv b_i^{SP} = 0$, $f_{1i} + g_{1i} = 1$ and $f_{2i} + g_{2i} = 1$, for all $i = 1, .., n$. The intratemporal allocation of resources over the two types of public goods is indeterminate because of their perfect substitutability in societies' welfare functions.

3.2. The ECB is able to commit

From now on, we assume that fiscal policies are decided at the decentralised level by the government which is in power.

Suppose that the ECB is able to commit to an inflation rate it announces before debt contracts are signed in period 1. Expected inflation equals the announced inflation rate and the term $\pi^e - \pi$ drops out of (2.4). Hence, the ECB finds it optimal to commit to a zero inflation rate.

Again, consider some EMU participant i ($i = 1, .., n$). In period 2, the amount of debt carried over from the first period is given. Hence, if party F is in power, it sets $f_{2i} = 1 - b_i$ and $g_{2i} = 0$. If party G is in power, it sets $f_{2i} = 0$ and $g_{2i} = 1 - b_i$. In period 1, party F chooses $f_{1i} = 1 + b_i$ and $g_{1i} = 0$, where b_i maximises party F's expected utility, which is given by $u(1 + b_i) + p(1 - b_i)$. Hence, the amount of debt chosen under commitment, b_i^C, is implicitly given by

$$u'(1 + b_i^C) = p. \tag{3.1}$$

Because $p < 1$, $b_i^C > 0$. Since $u'(2) < p$ by assumption, we have $b_i^C < 1$ and hence, debt repayments do not exceed second-period resources. Comparing b_i^C with b_i^{SP}, we

[5] The assumption of commitment is not strictly necessary with the normalisations we have imposed on $u(.)$. Even in the absence of commitment would the SP choose $b_i = 0$ ($i = 1, .., n$), and, hence, $\pi = 0$ (see the derivation of the solution of the model below).

see that the amount of debt will be suboptimally high from society's viewpoint if it is selected by the government in period 1. The reason is that the latter does not completely internalise the future benefits of lower debt. That is, it does not internalise society's benefit from the provision of good g_{2i} in the case that party G takes office the period 2. Equation (3.1) shows that a lower p implies a higher b_i^C. The lower the probability of a re-election, the more the incumbent discounts the future, and, hence, the more debt it issues.

3.3. Discretion

From now on we assume that the ECB is not able to commit. In period 2, therefore, the ECB chooses π so as to maximise (2.4), taking as given π^e. This yields:

$$\pi = \alpha \tilde{b}, \text{ where } \tilde{b} \equiv \frac{1}{n} \sum_{j=1}^{n} b_j. \tag{3.2}$$

Hence, the inflation rate is determined by the average stock of outstanding debt, $\tilde{b}$. An individual country's increase in public debt thus raises the common inflation rate, but only by "1 over n".

In period 1 the government of country i maximises over b_i:[6]

$$u(1 + b_i) + p(1 - b_i) - \frac{\alpha^2}{2\phi} \left(\frac{1}{n} \sum_{j=1}^{n} b_j \right)^2, \tag{3.3}$$

which yields the following first-order condition for b_i (where we remember to take into account the dependence of $\tilde{b}$ on b_i):

$$u'(1 + b_i) = p + \frac{\alpha^2}{\phi n} \tilde{b}. \tag{3.4}$$

In equilibrium, the selected amount of debt will be the same for each country. This is easy to see because the right hand side of (3.4) is the same for all i. The strict concavity of $u(.)$ thus guarantees that, in equilibrium, for all countries i $(i = 1, .., n)$, $b_i = b^{D,n}$, where the superscript n indicates the size of the monetary union. Hence, the equilibrium debt level and the equilibrium inflation rate are determined by:

[6]Note that from the perspective of the governments, when they select their debt levels, inflation expectations still need to be determined. Inflation expectations will adjust one-for-one with any effects of debt policy on future realised inflation. Hence, $\pi^e = \pi$ from the viewpoint of the governments when they choose their debt levels.

$$u'(1+b^{D,n}) = p + \frac{\alpha^2}{\phi n} b^{D,n}, \tag{3.5}$$

$$\pi^{D,n} = \alpha b^{D,n}. \tag{3.6}$$

3.3.1. National monetary policymaking ($n = 1$)

We have the following proposition:

Proposition 3.1. *Denote by V_S^r the equilibrium social welfare level under regime r, where $r = SP$ (=Social Planner), C (=Commitment) or D (=Discretion). One has:*

1. $0 = b^{SP} < b^{D,1} < b^C$.
2. $V_S^{SP} > Max[V_S^D, V_S^C]$.
3. V_S^D *may be higher than* V_S^C.

Proof:

1. *Immediate.*
2. *Define society's expected indirect utility function for given b, under the assumption that inflation is fixed at zero, by $V_S(b) \equiv u(1+b) + (1-b)$. It is easy to see that $V_S'(b) > 0$, for $b < 0$, and $V_S'(b) < 0$, for $b > 0$.*
3. *We show this by means of an example. Assume that $u(x) = -(\xi - 1)x^2/2 + \xi x$, where $\xi > 2 - p$. Clearly, on the interval $[0, \xi/(\xi - 1)]$ this function satisfies all our assumptions. Hence, from (3.5) we have that $b^{D,1} = (1-p)/((\alpha^2/\phi) + \xi - 1)$. Note that $1 + b^{D,1} < \xi/(\xi - 1)$, as required by our assumptions. Using the expression for $b^{D,1}$, we find (after some manipulation) that:*

$$V_S^D = 1\tfrac{1}{2} + \tfrac{1}{2}\xi - \tfrac{1}{2}\tfrac{(1-p)^2}{(\alpha^2/\phi)+\xi-1}. \tag{3.7}$$

Hence, for $\alpha \geq 0, \partial V_S^D/\partial\alpha > 0$. Use (3.5) and (3.6) to note that, if $\alpha \to 0$, $b^{D,1} \to b^C$ and $\pi^{D,1} \to \pi^C$ and, hence, $V_S^D \to V_S^C$. Hence, for the above specification of $u(.)$, one has $V_S^D > V_S^C$.

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Proposition 3.1 thus shows that discretion may yield higher social welfare than commitment. The reason for this rather counter-intuitive result is that the model features two distortions: a political distortion, leading to excessive debt, and the absence of commitment, leading to excessive inflation. Removing one distortion (the failure to commit) may worsen the other distortion (excessive debt). In particular, the incentive to issue too much debt is kept in check by the prospects of higher future inflation (compare with Obstfeld, 1991, Jensen, 1994, Van der Ploeg, 1995, and Beetsma and Bovenberg, 1997, where the same result is found in different models). Commitment, however, guarantees zero inflation on the outset and, thus, takes away the incentive to restrain debt accumulation. Apparently, for the utility function in *Proposition* 3.1*(3)* the welfare losses arising from excessive debt outweigh those arising from excessive inflation. However, note that, although commitment may not be optimal from the viewpoint of society at large, it *is* optimal for the party in power in period 1.

3.3.2. Supranational monetary policymaking ($n > 1$)

We have the following proposition:

Proposition 3.2. *Consider the discretionary case.*

1. *The equilibrium debt level is increasing both in the number of EMU participants and the degree of central bank independence.*

2. *Suppose that $\alpha = \phi$ (a completely dependent ECB). An increase in n reduces social welfare. In particular, transferring monetary policy from the national level (i.e., $n = 1$) to an ECB (i.e., $n > 1$) reduces social welfare.*

Proof:

1. *Follows immediately from (3.5).*

2. *If $\phi = \alpha$, (3.5) reduces to $u'(1 + b^{D,n}) = p + \phi b^{D,n}/n$. Hence, one has that $b^{D,1} < b^{D,2} < ...$ Because $\pi'(b) > 0$ (where $\pi(b)$ is inflation as a function of the equilibrium debt level, conform (3.6)) and $u(1 + b) + (1 - b)$ is decreasing in b for $b > 0$ (see the proof of Proposition 3.1(2)), $u(1+b)+(1-b)-\pi^2(b)/(2\phi)$ is*

decreasing in b if $b > b^{SP} = 0$. Moreover, using Proposition 3.1(1) we have that $b^{SP} < b^{D,1}$. Hence, societies' welfare is decreasing in the size of the union, n.

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The intuition for *Proposition* 3.2*(1)* is as follows: we saw earlier that the failure of the central bank to commit gives the first-period government the incentive to restrain debt accumulation. In a union this incentive is weakened, because the effect of a unilateral reduction in debt on the common inflation rate is only "1 over n " (see also Beetsma and Bovenberg, 1995). Hence, $b^{D,1} < b^{D,n} < b^{C}$ $(n > 1)$. Similarly, if the degree of central bank independence increases (i.e., α decreases; the ECB becomes more conservative), the incentive to restrain debt accumulation for the purpose of reducing future inflation also weakens.

4. Introducing a Stability Pact

The Stability Pact is an agreement by which countries will be punished for excessive deficits (or, equivalently, excessive debts). The implicit argument behind the punishments is that they help to avoid a situation in which the ECB has no other choice than to monetise the public debt.

We now want to analyse such a Stability Pact more formally. It may be good to recall the budget constraints (2.2) and (2.3): raising too much debt induces penalty payments, which are distributed to all the other countries in the Pact.

With perfect capital markets (so that the real interest is unaffected by other countries' policies) and in the absence of monetary unification, countries have no interest in surveying each other's debt policies, because there are no cross-country spillovers from individual countries' debt policies. Countries might want to sign a Stability Pact only for the purpose of tying the hands of their own governments.

But this all changes with a monetary union. Glimpsing at the results ahead, we will show that monetary unification strengthens the case for a Stability Pact. What is at work here is that, in a monetary union, an individual country's budgetary policy causes spillovers because it affects the common inflation rate in the union. A Stability Pact then becomes useful not only as a substitute for binding one's own government to a disciplined budgetary policy, but also as an instrument for surveying other countries' debt policies. Keep in mind, however, what was shown above: monetary unification first exacerbates the debt problem in the absence of a Stability Pact, because it di-

minishes the incentives to restrain debt for the purpose of lower future inflation. We therefore like to think of the monetary union already agreed upon for reasons outside the model: our focus is simply on the question of whether a Stability Pact can improve matters (it can) and whether it would do so as well in the absence of a monetary union (it does not). We therefore explain, why we see countries entering a Stability Pact only after they have already agreed to join a monetary union.

It is a good idea to first state some properties about the behaviour of the ECB as well as about the equilibrium utilities of countries and governments. As for the central bank, note that its behaviour purely depends on the equilibrium level of average debt, as equation (2.4) shows: the penalty payments all cancel in the aggregate. Thus, equation (3.2) continues to hold:

$$\pi = \alpha\tilde{b}, \text{ where } \tilde{b} \equiv \frac{1}{n}\sum_{j=1}^{n} b_j.$$

As for the equilibrium utilities in a symmetric equilibrium, we get the same cancellations of penalty payments and reimbursements from other countries:

Proposition 4.1. *Consider a symmetric equilibrium with debt level b in all countries and where the inflation rate is set by the central bank at $\pi = \alpha b$ as a function of the equilibrium level of debt. Then:*

1. *The equilibrium utility of the social planner is given by*

$$u(1+b) + (1-b) - \frac{\alpha^2}{2\phi}b^2 \tag{4.1}$$

   whereas the equilibrium utility of the government of country i is given by

$$u(1+b) + p(1-b) - \frac{\alpha^2}{2\phi}b^2 \tag{4.2}$$

2. *As functions of b, the equilibrium utility levels are strictly concave, achieving their maximum at $b = 0$ for the social planner and at $b^{D,1} > 0$ for the government,[7] where $b^{D,1}$ is implicitly defined in equation (3.5) for $n = 1$.*

3. *From the point of view of a government, an EMU with or without Stability Pact cannot be better than no EMU. Equality is achieved if and only if the debt levels set in an EMU with Stability Pact are equal to $b^{D,1}$.*

[7] This is not a typo: indeed, the maximum is *not* achieved at $b^{D,n}$, but at $b^{D,1}$.

Proof: *Straightforward. Note in particular that (4.2) coincides with (3.3) for* $n = 1$. •

4.1. The effects of a Stability Pact on debt accumulation

To obtain the debt level chosen by a government, one needs to consider the original statement of the problem and not the equilibrium utilities (4.2). Doing this, one sees that the first-order condition for the amount of debt selected by the government of country i in period 1 is now given by:

$$u'(f_{1i})(1-\psi_1) = p(1+\psi_2) + \frac{\alpha^2}{\phi n}\tilde{b}. \tag{4.3}$$

Note that $\bar{b}$ does not feature in (4.3) because $\bar{b}$ does not affect the marginal cost of an additional unit of debt. Again, this is due to the linearity assumption for our penalty function.

By symmetry, the equilibrium debt levels are equal for all participants. Hence, the equilibrium debt level is determined by the condition:

$$u'(1+b)(1-\psi_1) = p(1+\psi_2) + \frac{\alpha^2}{\phi n}b. \tag{4.4}$$

The effects of signing a Stability Pact on debt accumulation are illustrated in Figures 4.1 and 4.2. For convenience, we consider the cases of first-period and second-period punishments separately. Figure 4.1 assumes that $\psi_1 = 0$. Hence, the equilibrium debt level is determined by the intersection of the curves $y = u'(1+b)$ and $y = p(1+\psi_2) + \alpha^2 b/(\phi n)$ in Figure 4.1. A decrease in the degree of central bank independence increases the slope of the second curve and thus reduces the equilibrium debt level. We call this effect the "independence effect". An increase in ψ_2, the marginal punishment, causes an upward shift of this curve and further reduces the equilibrium debt level. This effect will be termed the "second-period punishment effect". In a sense, the effective real interest rate, $1+\psi_2$, is increased, which leads to a substitution away from present government consumption towards future government consumption.

Figure 4.2 assumes that $\psi_2 = 0$. Debt is unambiguously reduced by the "first-period punishment effect". The effective real interest rate, $1/(1-\psi_1)$, rises. Hence, current government consumption becomes more expensive in terms of future govern-

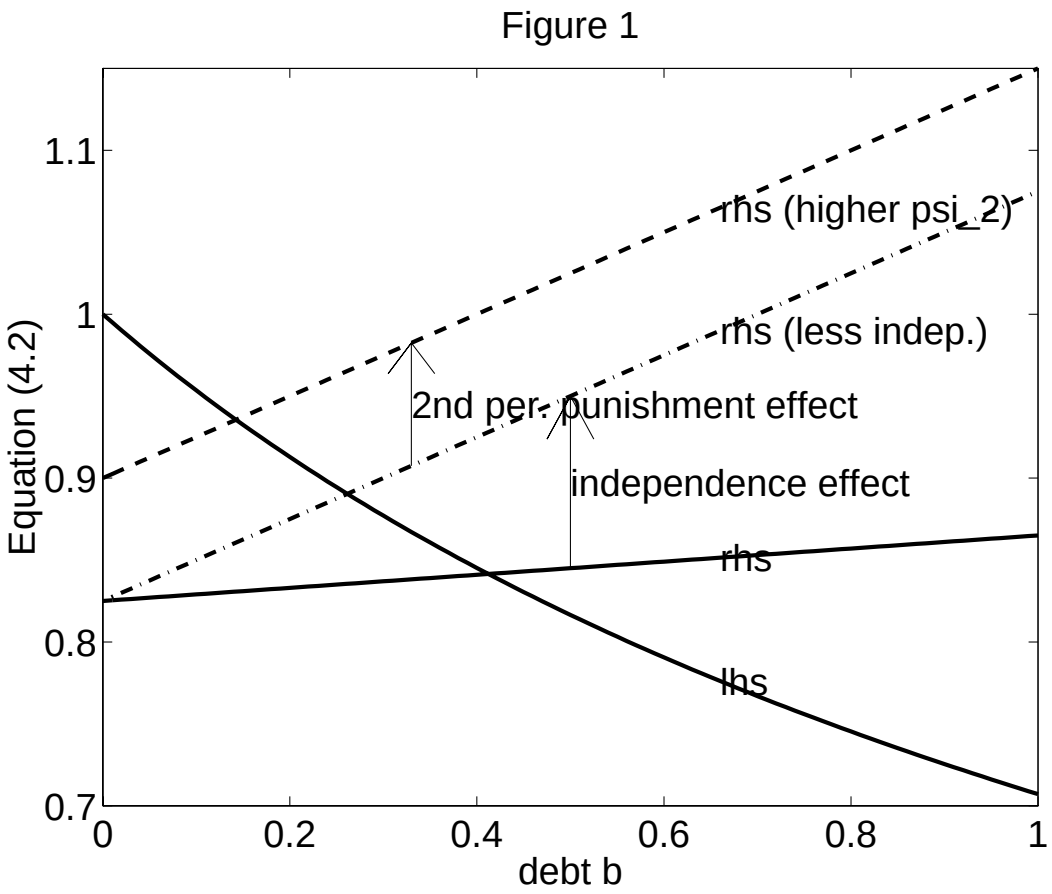

Figure 4.1: *This figure demonstrates the independence effect of increasing the level of central bank independence as well as the second-period punishment effect of increasing* ψ_2.

ment consumption, which leads to a substitution away from present towards future government consumption.

We summarise these insights and restate them formally:

Proposition 4.2. *For* $\psi_1 < 1$*, the equilibrium debt level* b *is a differentiable and strictly decreasing function of* ψ_1 *and* ψ_2*.*

Proof: *Use implicit differentiation.* •

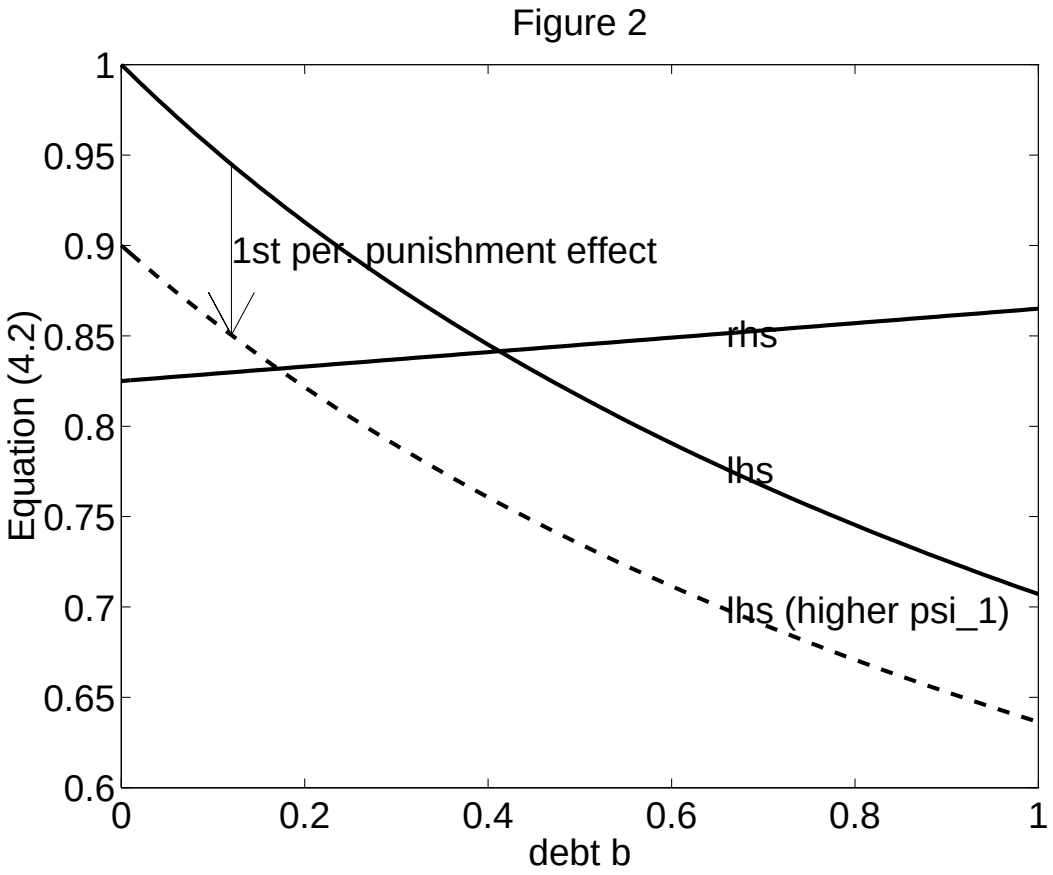

Figure 4.2: *This figure demonstrates the first-period punishment effect of increasing* ψ_1.

4.2. The optimal choice of a Stability Pact

Having established how a Stability Pact affects debt accumulation, we turn now to the problem of finding the optimal Stability Pact. We assume that it is signed before first-period policies are selected. As regards to the question who signs the Pact we consider two possibilities. The first is when a Constrained Social Planner (CSP) signs the Pact. The CSP maximises social welfare, but is constrained in that monetary policy is set by a central bank "out of control" of the social planner: this case therefore serves as a benchmark for the second and more interesting case in which the Pact is signed by the governments in power. These governments maximise their own utility rather than social welfare.

4.2.1. A CSP signs the Stability Pact

The CSP selects the punishment parameters ψ_1 and ψ_2. Hence, the equilibrium debt level is implicitly determined by (4.4), which we can rewrite as:

$$u'(1+b) = \frac{p(1+\psi_2)}{1-\psi_1} + \frac{\alpha^2}{\phi n}\left(\frac{1}{1-\psi_1}\right) b.$$

Hence, choosing $\psi_1 > 0$ and $\psi_2 > 0$ such that $p(1+\psi_2)/(1-\psi_1) = 1$ implies an equilibrium debt level of $b = 0$ and an inflation rate of zero. Hence, social welfare is maximised and is equal to that attained by an unconstrained social planner analysed previously. This shows that it is possible, in principle, for the countries in a monetary union to sign a Stability Pact offsetting the distortions caused by the common central bank, as long as debt levels are set by a "national referendum" rather than the particular and short-sighted government in power.

4.2.2. First-period governments sign the Stability Pact

We turn now to the case where the Stability Pact is signed by the governments of the participating countries at the start of the first period (i.e., before any policy measures are taken). We first consider the possibility of introducing a Stability Pact in the absence of a monetary union. We have the following proposition:

Proposition 4.3. *Suppose that monetary policy is selected at the national level ($n = 1$). Then, individual governments will be strictly worse off if they sign the Stability Pact.*[8]

Proof: *Note that "no Stability Pact" is equivalent to $\psi_1 = \psi_2 = 0$. Recall that the equilibrium debt level b is a strictly decreasing function of ψ_1 and ψ_2, see Proposition 4.2. Recall the strict concavity of (4.2) as a function of b, and the fact that (4.2) is maximised at $b = b^{D,1}$, the debt level chosen by a government without a Stability Pact and with its monetary policy set at the national level, see Proposition 4.1. The proposition above is now an immediate consequence.* •

The intuition for *Proposition* 4.3 is as follows. An individual government would want to choose an amount of debt equal to $b^{D,1} > 0$. From the viewpoint of an

[8] By signing a stability pact, we mean choosing ψ_1 or ψ_2 different from zero. The trivial case of $\psi_1 = \psi_2 = 0$ is excluded.

individual government, however, if $\psi_1 > 0$ and/or $\psi_2 > 0$, the marginal cost of an additional unit of debt increases, hence the chosen debt level is lower than $b^{D,1}$. The point is that an individual government fails to internalise that the other governments would also want to issue more debt and that no country would have to pay a fine if they all choose $b^{D,1}$.

Now, suppose instead, that a monetary union has been formed. We have the following proposition:

Proposition 4.4. *Suppose a monetary union is formed ($n > 1$). Then, for some $\bar{\psi}_1 > 0$ and $\bar{\psi}_2 > 0$, governments are strictly better off signing a Stability Pact with $0 \leq \psi_1 < \bar{\psi}_1$ and $0 \leq \psi_2 < \bar{\psi}_2$ and $\max[\psi_1, \psi_2] > 0$. Expected social welfare is also higher under any such Stability Pact chosen by the governments.*

Proof: *The proof is very similar to the proof of Proposition 4.3 and is, therefore, omitted.* •

Propositions 4.3 and 4.4 may explain why the discussion about a Stability Pact has emerged in the public debate now that the date for EMU has become close. While in the absence of an EMU, debt would be optimal *from the governments'* point of view (and a Stability Pact would only distort debt policy), in an EMU debt would be suboptimally high even from the perspective of the governments of the countries that will participate. In addition, even if some individual country would find some mechanism to restrict its future debt accumulation, it is still concerned about the excessive debt accumulation in other countries, because of the consequences for the common inflation rate. A Stability Pact would correct at least part of this distortion.

We now proceed to find the optimal Stability Pact that governments can sign. Under a union (with discretionary policymaking) governments attain their highest expected utility if and only if they sign a Stability Pact such that

$$\frac{p(1+\psi_2)}{(1-\psi_1)} + \frac{\alpha^2}{\phi n(1-\psi_1)} b^{D,1} = p + \frac{\alpha^2}{\phi} b^{D,1}$$

Thus, one needs to find a combination of punishment parameters $\psi_1 < 1$ and $\psi_2 > -1$ which achieve equality here. One example would be to set $\psi_1 = 0$ and solve for $\psi_2 > 0$. A second solution is to set $\psi_2 = 0$ and to solve for $0 < \psi_1 < (n-1)/n$. A third solution is to set $\psi_1 = (n-1)/n$ and $\psi_2 = (1-n)/n$. Obviously, there are many others.

Such a Pact yields strictly higher utility for the governments than a monetary union without a Stability Pact because the associated debt level in the latter case is higher than $b^{D,1}$, as was shown in *Proposition* 3.2. Furthermore an increase in n induces increasing debt levels in the absence of a Stability Pact, and therefore requires increases in the punishment parameters ψ_1 or ψ_2 to nonetheless achieve the optimal debt level $b^{D,1}$. This is not surprising, given that the incentive to internalise the inflationary consequences of running excessive debts is weakened by an increase in the size of the union.

5. Extension: shocks to the budget

The preceding analysis raises the question why countries seem to have felt compelled to entertain a EMU anyhow. After all, as *Proposition* 4.1 showed, each country's government would have been better off without EMU and without a Stability Pact than with EMU and some non-optimal Stability Pact. Even with an optimal Stability Pact, the government can at most be as well off.

Of course, there are presumably many other issues that are of importance in assessing the desire for an EMU aside from the issues studied in this paper. One possible defense for our purposes here is thus to simply assume that an EMU is desirable somehow for exogenous reasons, and that our analysis simply pertains to the added desirability of a Stability Pact.

However, it is interesting that a rationale for both can be found even within our analysis. We are now going to show that the governments will actually *prefer* EMU with a well-designed Stability Pact to the case of autonomy (that is, neither monetary unification nor a Stability Pact). This, of course, requires a slight change in the assumptions made so far. The change is an appealing one: we assume that the first-period budget constraints are subject to shocks ϵ_i, which change the countries' first-period endowment from 1 to $1 + \epsilon_i$. The shocks are assumed to be identically and symmetrically distributed, with a mean of zero and finite variance. Moreover, they are assumed to uncorrelated across countries.[9] To keep things simple, no changes are

[9] Allowing for shocks that are correlated across countries does not yield much additional insight and is, therefore, left out of consideration.

made with respect to the second-period budget constraint. Formally, thus,

$$f_{1i} + g_{1i} = 1 + b_i + \epsilon_i - \psi_1(b_i - \bar{b}) + \left(\frac{1}{n-1}\right) \sum_{j=1, j\neq i}^{n} \psi_1(b_j - \bar{b}), \tag{5.1}$$

$$f_{2i} + g_{2i} = 1 - b_i[1 + \pi^e - \pi] - \psi_2(b_i - \bar{b}) + \left(\frac{1}{n-1}\right) \sum_{j=1, j\neq i}^{n} \psi_2(b_j - \bar{b}). \tag{5.2}$$

Note that the federal budget is again balanced on a period by period basis.

We assume that the Stability Pact has to be signed *before* the realisations of the shocks are known, but that the debt levels of the individual countries are chosen *after* the shocks are known. Monetary policy is set as before in a discretionary manner in the second period either by a national central bank or by the ECB in the case of an EMU. We will show, that in *expected* utility terms, the government of each country is better off with an EMU and a well-designed Stability Pact.

To this end, we first consider the solution to the autonomous case (denoted by superscript "A"). Given some shock ϵ,[10] let $V^A(\epsilon)$ be the indirect utility of a first-period government in the single-country case with a discretionary national central bank, where the government has chosen its most preferred debt level $b^A(\epsilon)$, i.e.

$$V^A(\epsilon) \equiv \max_b \left[u(1 + \epsilon + b) + p(1 - b) - \frac{\alpha^2}{2\phi} b^2 \right] \tag{5.3}$$

It is useful to note that:

Proposition 5.1. *$V^A(\cdot)$ is an increasing, strictly concave function in ϵ.*

Proof: *Maximising a strictly concave function results in a strictly concave function. Clearly, $V^A(\cdot)$ is increasing.* •

Consider now n countries with idiosynchratic mean-zero shocks ϵ_i, which are distributed symmetrically around zero. Let

$$\tilde{\epsilon} = \frac{1}{n} \sum_{i=1}^{n} \epsilon_i$$

be the "average" shock. We now assume that there is a Stability Pact and that countries form an EMU with the central bank behaving in a discretionary manner as

[10] If the argument of the utility function $u(\cdot)$ is restricted to a certain range, then it shall be implicitly assumed that ϵ is restricted to a range such that a solution for $b(\epsilon)$ exists.

before (we denote this case with superscript "E"). In particular, inflation is still set according to equation (3.2). Furthermore, the first-order condition for government i is again given by (4.3). For each government, the right-hand side of the first-order condition (4.3) is the same. The monotonicity of u' then implies that f_1^E is the same for each government, which is only possible if, for each government i $(i = 1, .., n)$,

$$f_{1i}^E = 1 + \tilde{b}^E + \tilde{\epsilon} \tag{5.4}$$

Combine this with the right hand side of (5.1), which gives (after some algebra):

$$b_i^E = \tilde{b}^E + \left(\frac{1}{1 - \psi_1 \left(\frac{n}{n-1} \right)} \right) (\tilde{\epsilon} - \epsilon_i), \tag{5.5}$$

Hence, the difference between country i's debt and the average debt level is proportional to $(\tilde{\varepsilon} - \varepsilon_i)$, with a proportionality factor that depends on ψ_1, but not on ψ_2. As long as $0 \leq \psi_1 < (n-1)/n$, an increase in ψ_1 leads to a dispersion of debt levels across the union! We formulate these insights as a proposition:

Proposition 5.2. *In a monetary union with a Stability Pact and idiosynchratic shocks to the first-period budget constraints of countries, fiscal first-period expenditures in all countries are equal. Furthermore, the higher the first-period punishment for excessive debt, the greater the debt dispersion.*

The intuition is as follows: Suppose that $\epsilon_i < 0$. Hence, the government of country i has relatively few resources in the first period and, therefore, wants to issue debt. This would require paying a fine to the federal budget and would result in even less resources. The government tries to make up for this loss by borrowing even more. The effect of a shock on the public debt is amplified by the Stability Pact. In fact, this amplification mechanism has been the cause of some criticism against the Stability Pact.

Our goal is instead to show that individual countries are better off with EMU and a well-designed Stability Pact:

Proposition 5.3. *Let $\psi_1(k) = [(n-1)/n] - 1/k$ and $\psi_2(k) = [(1-n)/n] + 1/k = -\psi_1(k)$. Then, the expected utility of each government in an EMU with a Stability Pact characterised by $\psi_1(k)$ and $\psi_2(k)$ is given by $E[V^A(\tilde{\epsilon})]$, if we let $k \to \infty$. This expected utility is strictly higher than the expected utility $E[V^A(\epsilon_i)]$ in the autonomous case, unless the shocks are almost surely identical to zero.*

Proof: *Consider some country i ($i = 1, .., n$). We assume that the shocks are not trivial, i.e. that they are not almost surely identical to zero. First, we note that $\tilde{\epsilon}$ is less risky than ϵ_i, i.e. one can write*

$$\epsilon_i =^d \tilde{\epsilon} + \nu_i, \tag{5.6}$$

where ν_i is a nontrivial mean-zero random variable uncorrelated with $\tilde{\epsilon}$ and where $=^d$ means "distributed as". One way to see this is to use the characterisation in the Appendix of Chapter 5, p. 137, in Ingersoll (1987) of "second-order stochastic dominance", which coincides with (5.6) for equal means: it suffices to show that[11]

$$\int_{-\infty}^{t} F(x)dx \leq \int_{-\infty}^{t} G(x)dx, \text{ all } t,$$

where $F(\cdot)$ is the cumulative distribution function of ϵ_i and $G(\cdot)$ is the cumulative distribution function of $\tilde{\epsilon}$. However, this is immediately clear for $t \leq 0$ and then follows for $t \geq 0$, because

$$\int_{-t}^{0} [F(x) - G(x)]\, dx = \int_{0}^{t} [G(x) - F(x)]\, dx,$$

since the shocks were assumed to be symmetrically distributed around zero.

With (5.6), we can now follow the proof of Theorem 1 in Chapter 5 in Ingersoll (1987). By Jensen's inequality and due to the strict concavity of $V^A(\epsilon)$,

$$E[V^A(\tilde{\epsilon} + \nu_i) \mid \tilde{\epsilon}] < V^A(E[\tilde{\epsilon} + \nu_i \mid \tilde{\epsilon}]) = V^A(\tilde{\epsilon}).$$

Hence,

$$E[V^A(\epsilon_i)] = E[E[V^A(\tilde{\epsilon} + \nu_i) \mid \tilde{\epsilon}]] < E[V^A(\tilde{\epsilon})]. \tag{5.7}$$

It now remains to show that $E[V^A(\tilde{\epsilon})]$ is indeed the expected utility of a country participating in an EMU with a Stability Pact with the parameters $\psi_1(k)$ and $\psi_2(k)$, where $k \to \infty$.

If the government of country i is re-elected, then, using (5.2), one can write

$$f_{2i}^E = 1 - b_i^E(k) \left[1 + \psi_2(k) \left(\frac{n}{n-1}\right)\right] + \left(\frac{n}{n-1}\right) \psi_2(k)\, \tilde{b}^E(k),$$

where $\tilde{b}^E(k)$ is the average debt level and $b_i^E(k)$ is country i's debt level in a union with Stability Pact parameters $\psi_1(k)$ and $\psi_2(k)$. Substituting the right-hand side of

[11] Note, that ν_i cannot be almost surely equal to zero, since that would otherwise imply that ϵ_i and $\tilde{\epsilon}$ have the same distribution.

(5.5) for $b_i^E(k)$ *and using that* $\psi_2(k) = -\psi_1(k)$ *yields* $f_{2i}^E = 1 - \tilde{b}^E(k) + \epsilon_i - \tilde{\epsilon}$. *Hence, using (5.4), the expected utility of country i's government, for given Stability Pact parameters* $\psi_1(k)$ *and* $\psi_2(k) = -\psi_1(k)$ *and conditional on the individual shock* ϵ_i *and the average shock* $\tilde{\epsilon}$, *is:*

$$u\left[1 + \tilde{\epsilon} + \tilde{b}^E(k)\right] + p\left[1 - \tilde{b}^E(k) + \epsilon_i - \tilde{\epsilon}\right] - \frac{\alpha^2}{2\phi}\left[\tilde{b}^E(k)\right]^2 \equiv V^E(k) \tag{5.8}$$

Equations (4.3) and (5.4) imply that $\tilde{b}^E(k)$ *is implicitly defined by*

$$u'\left[1 + \tilde{\epsilon} + \tilde{b}^E(k)\right] = p + \frac{\alpha^2}{\phi n(1 - \psi_1(k))}\tilde{b}^E(k).$$

where we have again used that $\psi_2(k) = -\psi_1(k)$. *If* $k \to \infty$, *this condition converges to*

$$u'\left[1 + \tilde{\epsilon} + \tilde{b}^E(\infty)\right] = p + \frac{\alpha^2}{\phi}\tilde{b}^E(\infty).$$

However, this is exactly the first-order condition for an autonomous country, which experiences the average shock $\tilde{\epsilon}$. *Hence, if* $k \to \infty$, $\tilde{b}^E(k) \to b_i^A(\tilde{\epsilon})$, *where* $b_i^A(\tilde{\epsilon})$*is the debt level selected by government i in autonomy, if its budget is hit by a shock of size* $\tilde{\epsilon}$ *(conform (5.3)). Hence, by equation (5.8), one has that*

$$\begin{aligned}\lim_{k\to\infty} E\left[V^E(k)\right] &= E\left\{u\left[1 + \tilde{\epsilon} + b_i^A(\tilde{\epsilon})\right] + p\left[1 - b_i^A(\tilde{\epsilon})\right] - \frac{\alpha^2}{2\phi}\left[b_i^A(\tilde{\epsilon})\right]^2\right\} \\ &= E\left[V^A(\tilde{\epsilon})\right].\end{aligned}$$

This finishes the proof. •

Note that if $k \to \infty$ in *Proposition* 5.3, the dispersion of the debt levels across the union becomes infinitely wide [see (5.5)]. However, because EMU in combination with the limiting Pact in *Proposition* 5.3 is *strictly* better than autonomy [see equation (5.7)], there exists a $k < \infty$ such that EMU in combination with a Pact characterised by $\psi_1(k)$ and $\psi_2(k)$ is strictly preferred to autonomy.

The intuition behind *Proposition* 5.3 is clear. Without an EMU, inflation will have to move one-for-one with changes in a country's debt. Since countries are quadratically averse against inflation by assumption, they dislike variance in the debt. In an EMU, inflation will move one-for-one with the changes in the *average* level of debt, and hence will be less variable. This potentially beneficial effect of an EMU might be undone

due to the heightened incentive of countries to run higher debt levels at the cost of their neighbours. However, this incentive is exactly compensated for via the Stability Pact: it turns out that the exact compensation requires a huge penalty for debt in the first period and a huge subsidy in the second period.

6. Conclusion

This paper has investigated the proposed Stability Pact for the countries that are to form an EMU. In particular, we have explained why countries that would otherwise not want to sign a Stability Pact do want to sign such a Pact if they indeed go ahead with monetary unification. The reason is that in a monetary union debt would be too high (both from societies' perspective as well as from the perspective of the first-period governments), because governments fail to fully internalise the benefits of reducing the debt in terms of lower future inflation.

We have also shown that with a stochastic first-period budget, countries strictly prefer to enter an EMU with a well-designed Stability Pact than to remain autonomous. The reason is that in an EMU inflation is attuned to the average debt level and is therefore more stable than inflation in the autonomous case. The role of the Stability Pact is to correct the average debt bias which arises in a union in which the governments do not fully internalise the inflationary consequences of their debt policies.

References

[1] Alesina, Alberto and Guido Tabellini, 1990, "A Positive Theory of Fiscal Deficits and Government Debt," *Review of Economic Studies*, 57, 403-414.

[2] Beetsma, Roel and A. Lans Bovenberg, 1995, "Does Monetary Unification Lead to Excessive Debt Accumulation?," *Discussion Paper*, No.1299, Centre for Economic Policy Research, London.

[3] Beetsma, Roel and A. Lans Bovenberg, 1997, "Central Bank Independence and Public Debt Policy," *Journal of Economic Dynamics and Control*, forthcoming.

[4] Bohn, Henning, 1988, "Why Do We Have Nominal Government Debt?," *Journal of Monetary Economics*, 21, 121-140.

[5] Calvo, Guillermo and Pablo Guidotti, 1993, "On the Flexibility of Monetary Policy: The Case of the Optimal Inflation Tax," *Review of Economic Studies*, 60, 667-687.

[6] CEPR, 1991, *Monitoring European Integration: The Making of Monetary Union,* Centre for Economic Policy Research, London.

[7] Cukierman, Alex, 1992, *Central Bank Strategy, Credibility and Independence,* MIT Press.

[8] Cukierman, Alex, Edwards, Sebastian and Guido Tabellini, 1992, "Seignorage and Political Instability," *American Economic Review*, 82, 537-555.

[9] The Economist, 1997, "German Fears about EMU," January 25.

[10] de Grauwe, Paul, 1994, *The Economics of Monetary Integration,* Oxford University Press, second edition.

[11] Dornbusch, Rudi, 1996, "Debt and monetary policy: the policy issues," NBER working paper 5573.

[12] Eijffinger, Sylvester and Jakob de Haan, 1996, "The Political Economy of Central-Bank Independence," *Special Papers in International Economics*, No. 19, International Finance Section, Princeton.

[13] Giavazzi, Francesco (ed.), 1988, *The European Monetary System,* Cambridge University Press.

[14] Giovannini, Alberto (ed.), 1996, *The Debate on Money in Europe,* MIT Press.

[15] Ingersoll, Jonathan E., 1987, *Theory of Financial Decision Making,* Rowman and Littlefield, Maryland.

[16] Jensen, Henrik, 1994, Loss of Monetary Discretion in a Simple Dynamic Policy Game, *Journal of Economic Dynamics and Control*, 18, 763-779.

[17] Kenen, Peter B., 1995, *Economic and Monetary Union in Europe: Moving Beyond Maastricht,* Cambridge University Press.

[18] Lucas, Robert E., Jr. and Nancy L. Stokey, 1983, "Optimal Fiscal and Monetary Policy in an Economy without Capital," *Journal of Monetary Economics*, 12, 55-93.

[19] Obstfeld, Maurice, 1991, Dynamic Seigniorage Theory: An Exploration, *Discussion Paper*, No.519, Centre for Economic Policy Research, London.

[20] Persson, Torsten and Guido Tabellini, eds., 1994, *Monetary and Fiscal Policy, volume 1: Credibility*, MIT Press.

[21] Persson, Torsten and Guido Tabellini, eds., 1994, *Monetary and Fiscal Policy, volume 2: Politics*, MIT Press.

[22] Ploeg, Frederick van der, 1995, Political Economy of Monetary and Budgetary Policy, *International Economic Review*, 36, 427-439.

[23] Rogoff, Kenneth, 1985, "The Optimal Degree of Commitment to an Intermediate Monetary Target," *Quarterly Journal of Economics*, 99, 1169-1189.

[24] Tabellini, Guido and Alberto Alesina, 1990, "Voting on the Budget Deficit," *American Economic Review*, 80, 37-49.

[25] Uhlig, Harald, 1997, "Long-Term Debt and the Political Support for a Monetary Union," *Discussion Paper*, No.1603, Centre for Economic Policy Research, London.